



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.03.2021 Bulletin 2021/13

(51) Int Cl.:
G07D 11/00 (2019.01)

(21) Application number: **19807704.2**

(86) International application number:
PCT/JP2019/016240

(22) Date of filing: **16.04.2019**

(87) International publication number:
WO 2019/225223 (28.11.2019 Gazette 2019/48)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Japan Cash Machine Co., Ltd.**
Osaka-shi, Osaka 547-0035 (JP)

(72) Inventors:
• **UEMIZO Yoshiaki**
Osaka-shi, Osaka 547-0035 (JP)
• **UEDA Takashi**
Osaka-shi, Osaka 547-0035 (JP)

(30) Priority: **22.05.2018 JP 2018097802**

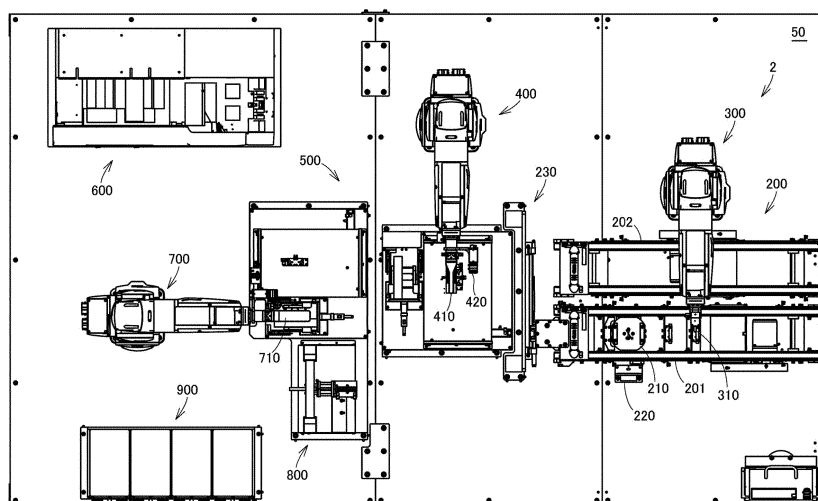
(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(54) **AUTOMATIC BANKNOTE HANDLING SYSTEM**

(57) An automatic banknote handling system includes a transporter (200) that transports a banknote storage container (10) for storing banknotes, a first arm (300) that unlocks the banknote storage container (10) and opens a lid (11) of the banknote storage container (10), a banknote aligner (500) that aligns the banknotes, a banknote sorter (600) that sorts the banknotes placed in an entrance portion by denominations, a second arm (400) that removes the banknotes stored in the banknote

storage container (10), places the banknotes on the banknote aligner (500), and places the aligned banknotes in the entrance portion of the banknote sorter (600), a banknote strapper (800) that straps the banknotes, and a third arm (700) that passes a predetermined number of banknotes sorted by denominations to the banknote strapper (800), and removes a strapped bundle of banknotes from the banknote strapper (800) and places the bundle at a predetermined position.

FIG. 1



Description

FIELD

[0001] The present invention relates to a technique for an automatic banknote handling system that transports and sorts banknotes.

BACKGROUND

[0002] A known automatic banknote handling system transports and sorts banknotes. For example, Japanese Unexamined Patent Application Publication No. 62-92095 (Patent Literature 1) describes a cash handling apparatus incorporating an articulated robot. The cash handling apparatus described in Patent Literature 1 includes a banknote receiving and aligning unit, a banknote counting and sorting unit, a cash cassette unit, a banknote transfer mechanism including the articulated robot. The banknote receiving and aligning unit receives and aligns banknotes, and passes the banknotes to a robot hand. The banknote counting and sorting unit receives the banknotes from the robot hand and counts and sorts the banknotes. The cash cassette unit stores the banknotes received from the robot hand in a container, and pulls and removes the banknotes from the container and passes the banknotes to the robot hand. The banknote counter unit receives the banknotes, verifies the count, and passes the banknotes to the robot. The banknote dispenser unit receives the banknotes from the robot and feeds the banknotes to a dispensing slot. The banknote transfer mechanism transfers the banknotes between these units using the articulated robot.

[0003] Japanese Unexamined Patent Application Publication No. 2016-31619 (Patent Literature 2) describes a storage work device, a valuable medium storage system, and a storage work method. A work robot described in Patent Literature 2 captures an image of the appearance of a cassette with a camera mounted on the head of the work robot, and identifies the type of the cassette through image processing. The work robot opens the cassette using a tool and a procedure defined for the type of the cassette. The work robot then captures an image of the inside of the cassette, and detects any abnormality through image processing. The work robot also captures an image of a banknote sorter, and identifies banknotes to be removed through image processing. The work robot then removes the banknotes from the banknote sorter and stores the banknotes into the cassette. The work robot closes the cassette using a tool and a procedure defined for the type of the cassette.

[0004] Japanese Unexamined Patent Application Publication No. 2016-224664 (Patent Literature 3) describes a valuable medium processing system and a valuable medium processing method. A banknote handling system described in Patent Literature 3 moves a bundle of banknotes tied with a currency strap, with a work robot

holding the banknote bundle, to a position at which the bundle can be unstrapped by a bundle unstrapping unit. The bundle unstrapping unit cuts and removes the strap from the banknote bundle. The work robot then stores the bundle into the cassette. This system can use a bundle of banknotes tied with a currency strap to replenish the cassette, and thus efficiently stores banknotes in the cassette.

10 CITATION LIST

PATENT LITERATURE

[0005]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 62-92095

Patent Literature 2: Japanese Unexamined Patent Application Publication No. 2016-31619

Patent Literature 3: Japanese Unexamined Patent Application Publication No. 2016-224664

BRIEF SUMMARY

25 TECHNICAL PROBLEM

[0006] An object of the present invention is to provide an automatic banknote handling system that is easy to use.

SOLUTION TO PROBLEM

[0007] An automatic banknote handling system according to one aspect of the present invention includes a transporter that transports a banknote storage container for storing banknotes, a first arm that unlocks the banknote storage container and opens a lid of the banknote storage container, a banknote aligner that aligns the banknotes, a banknote sorter that sorts the banknotes placed in an entrance portion by denominations, a second arm that removes the banknotes stored in the banknote storage container, places the banknotes on the banknote aligner, and places the aligned banknotes in the entrance portion of the banknote sorter, a banknote strapper that straps the banknotes, and a third arm that passes a predetermined number of banknotes sorted by denominations to the banknote strapper, and removes a strapped bundle of banknotes from the banknote strapper and places the bundle at a predetermined position.

ADVANTAGEOUS EFFECTS

[0008] The above aspect of the present invention provides an automatic banknote handling system that is easy to use.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

Fig. 1 is a plan view of an automatic banknote handling system 1 according to an embodiment.

Fig. 2 is a front view of the automatic banknote handling system 1 according to the embodiment.

Fig. 3 is a functional block diagram of the automatic banknote handling system 1 according to the embodiment.

Fig. 4 is a flowchart showing a procedure performed by the automatic banknote handling system 1 according to the embodiment.

Fig. 5 is a perspective view of a banknote storage container 10 according to the embodiment with a lid 11 being open.

Fig. 6 is a functional block diagram of the automatic banknote handling system 1 according to a modification.

DETAILED DESCRIPTION

[0010] Embodiments of the present invention will now be described with reference to the drawings. The same components are herein given the same reference numerals. Those components have the same names and functions, and will not be described repeatedly.

First Embodiment

Overall Configuration of Automatic Banknote Handling System 1

[0011] As shown in Figs. 1 to 3, an automatic banknote handling system 1 according to the present embodiment mainly includes a controller 100, a transporter 200, a first arm 300, a second arm 400, a banknote aligner 500, a banknote sorter 600, a third arm 700, a banknote strapper 800, and storage boxes 900. In the present embodiment, the transporter 200, the first arm 300, the second arm 400, the banknote aligner 500, the banknote sorter 600, the third arm 700, the banknote strapper 800, and the storage boxes 900 are mounted on a base 50, and the controller 100 is located under the base 50.

[0012] The controller 100 includes a memory 120, which stores various programs and data, a communication interface 160, which transmits and receives data to and from the units included in the automatic banknote handling system 1, or specifically the transporter 200, the first arm 300, the second arm 400, the banknote aligner 500, the third arm 700, and the banknote strapper 800, and a central processing unit (CPU) 110, which controls the controller 100 and the units in the automatic banknote handling system 1 through the communication interface 160 in accordance with programs.

[0013] The units in the automatic banknote handling system 1 associated with transporting, unlocking, and

opening of the banknote storage container 10 and also removal of banknotes from the container, and so on, are collectively referred to as a banknote storage container handling system 2 or an unlocking system 2.

Operation Overview of Automatic Banknote Handling System 1

[0014] The operation of the automatic banknote handling system 1 according to the present embodiment will now be described with reference to Figs. 1 to 4.

[0015] The transporter 200 transports the banknote storage container 10 (refer to Fig. 5) in response to a command from the controller 100 (step S102). The transporter 200 transports the banknote storage container 10, which is brought into the room containing the automatic banknote handling system 1, to near the first arm 300. In the present embodiment, the transporter 200 includes a first conveyor 201, a second conveyor 202, a reverser 210, a radio frequency identification (RFID) antenna 220, and a transfer unit 230.

[0016] The controller 100 determines one surface of the banknote storage container 10 having a keyhole 12, or the surface having a lid 11, based on data received from the RFID antenna 220 (step S104). As described in detail later, the banknote storage container 10 in the present embodiment has an RFID tag attached to its one surface having no keyhole 12. When the RFID antenna 220 detects an RFID tag, the controller 100 determines, based on a signal from the RFID antenna 220, that the lid 11 and the keyhole 12 are on the surface opposite to the RFID antenna 220, and directly passes the banknote storage container 10 to the transfer unit 230.

[0017] In the present embodiment, the transfer unit 230, which includes slides 231 and 232, transports the banknote storage container 10 from the first conveyor 201 to the second conveyor 202.

[0018] When the RFID antenna 220 detects no RFID tag, the controller 100 determines, based on a signal from the RFID antenna 220, that the banknote storage container 10 has the lid 11 and the keyhole 12 on its surface facing the RFID antenna 220. The controller 100 uses the reverser 210 to turn the banknote storage container 10 to have the surface with the lid 11 and the keyhole 12 facing the first arm 300 (step S106). The controller 100 passes the turned banknote storage container 10 to the second conveyor 202.

[0019] The first arm 300 includes a key 310 for unlocking the lid 11 of the banknote storage container 10. As described later, the first arm 300 moves the key 310 front and back, right and left, and up and down or rotates the key 310 in response to a command from the controller 100 and inserts the key 310 into the keyhole 12 of the banknote storage container 10. In response to a command from the controller 100, the first arm 300 rotates the key 310 to unlock the banknote storage container 10, and then opens the lid 11. In detail, the controller 100 uses data indicating the vertical position of the keyhole

12 obtained from a camera and data indicating the angle of rotation of the keyhole 12 to correct the angle of rotation of the key 310 (by rotating the arm) before moving the first arm 300 to the keyhole 12.

[0020] The second arm 400 includes a gripper 410 for picking banknotes. In response to a command from the controller 100, the second arm 400 moves the gripper 410 front and back, right and left, and up and down and picks banknotes stored in the banknote storage container 10, removes the banknotes, or places the banknotes onto the banknote aligner 500.

[0021] The controller 100 controls the first arm 300 to lock the banknote storage container 10. The controller 100 controls the second conveyor 202 of the transporter 200 to transport the empty banknote storage container 10 out of the room.

[0022] As described in detail later, the second arm 400 has a camera 420 mounted near the gripper 410 in the present embodiment. The control described below is performed. The controller 100 operates the transporter 200 to move the banknote storage container 10 to a position near and facing the first arm 300. The controller 100 operates the camera 420 on the second arm 400 to capture an image of the front face of the banknote storage container 10 (step S108). The controller 100 determines the position of the keyhole 12 based on the image data (step S110). The controller 100 controls the first arm 300 to move the key 310 to the keyhole 12 and insert the key 310 into the keyhole 12. The controller 100 controls the first arm 300 to turn the key 310 (step S112). The controller 100 controls the first arm 300 to open the lid of the banknote storage container 10 (step S114). The controller 100 controls the second arm 400 to move the gripper 410 into the banknote storage container 10. The controller 100 controls the second arm 400 to pick the banknotes using the gripper 410. The controller 100 controls the second arm 400 to pull and remove the banknotes (step S116). The controller 100 controls the second arm 400 to turn the gripper 410 by 90° to allow the banknotes to stand upright on their edges. The controller 100 controls the second arm 400 to place the banknotes in the banknote aligner 500.

[0023] In response to a command from the controller 100, the banknote aligner 500 aligns the banknotes. More specifically, the banknote aligner 500 aligns the edges of a bundle of banknotes (step S118). More specifically, the banknote aligner 500 in the present embodiment uses a plate to laterally support the standing banknotes placed by the second arm 400 to prevent the banknotes from falling. The banknote aligner 500 then vibrates the banknotes using a vibrator (not shown) to align the lower edges and the lateral edges of the standing banknotes. The banknote aligner 500 in the present embodiment can also align the upper edges of the vibrating banknotes by pressing the banknotes with a plate above while the banknotes are being vibrated.

[0024] The controller 100 controls the second arm 400, which has been in a standby state during the aligning

process, to pick the aligned banknotes again. The controller 100 controls the second arm 400 to place the aligned banknotes in an entrance slot of the banknote sorter 600. In the present embodiment, the controller 100 controls the second arm 400 to push the banknotes placed in the entrance slot inward with the tip of the gripper 410. The banknote sorter 600 sorts the banknotes from the second arm 400 by their denominations, and stores the banknotes separately for each denomination (step S120).

[0025] In the present embodiment, the banknote sorter 600 may reject an unsorted banknote. When the banknote sorter 600 rejects a banknote (Yes in step S122), the controller 100 controls the third arm 700 to pick a rejected banknote using the gripper 710. The controller 100 controls the second arm 400 to receive the rejected banknote from the third arm 700 using the gripper 410. The controller 100 then places the banknote again in the entrance slot of the banknote sorter 600 (step S120).

[0026] In the present embodiment, the banknote sorter 600, when sorting the banknotes, displays the counts of banknotes stored for each denomination. The banknote sorter 600 stops sorting when the count of banknotes reaches a predetermined number for each denomination, for example, 100. In the present embodiment, the third arm 700 also has a camera. Using an image captured with the camera, the controller 100 obtains the count of sorted banknotes for each denomination. When the banknotes sorted for any denomination reach a predetermined count, the controller 100 controls the third arm 700 to pick the banknotes and pass the banknotes to the banknote strapper 800 using the gripper 710. The banknote aligner 500 may preferably align the banknotes again before passing the banknotes to the banknote strapper 800.

[0027] The banknote strapper 800 straps a bundle of a predetermined number of banknotes (step S124). The controller 100 controls the third arm 700 to pick the strapped bundle of banknotes and place the banknotes in one of the storage boxes 900. In the present embodiment, each storage box 900 receives banknotes of its corresponding denomination. The controller 100 controls the third arm 700 to place banknotes of the same denomination tied with a strap into the corresponding storage box 900 intended for the denomination (step S126).

[0028] As described above, the automatic banknote handling system 1 according to the present embodiment automatically sorts banknotes stored in the locked banknote storage container 10 by their denominations into each strapped bundle of a predetermined number of banknotes of the same denomination. The automatic banknote handling system 1 thus allows safer and more convenient handling of banknotes.

[0029] In the above embodiment, the third arm 700 has the camera, and the controller 100 determines whether the count of banknotes of each denomination reaches a predetermined number using an image captured with the camera. However, the banknote sorter 600 may transmit

data indicating the count of banknotes sorted for each denomination or a notification that the banknote count reaches a predetermined number to the controller 100. In this case, the third arm 700 may have no camera.

[0030] In the above embodiment, the automatic banknote handling system 1 includes the first arm 300 having the key 310 and the second arm 400 having the camera 420. However, the second arm 400 may have a key and the first arm 300 may have the gripper 410 for picking banknotes.

[0031] The above embodiment may be modified. The function of each of the units in the above embodiment may be achieved by another unit. The function of a single unit may be achieved by a plurality of units, or the functions of a plurality of units may be achieved by a single unit. As shown in Fig. 6, for example, a controller in the first arm 300 or in the second arm 400 may function as the controller 100. A CPU or a memory in the camera 420 or the controller in the first arm 300 or another unit may perform the processing of the controller 100.

Overview

[0032] An automatic banknote handling system 1 according to the above embodiment includes a transporter 200 that transports a banknote storage container 10 for storing banknotes, a first arm 300 that unlocks the banknote storage container 10 and opens a lid 11 of the banknote storage container 10, a banknote aligner 500 that aligns the banknotes, a banknote sorter 600 that sorts the banknotes placed in an entrance portion by denominations, a second arm 400 that removes the banknotes stored in the banknote storage container 10, places the banknotes on the banknote aligner 500, and places the aligned banknotes in the entrance portion of the banknote sorter 600, a banknote strapper 800 that straps the banknotes, and a third arm 700 that passes a predetermined number of banknotes sorted by denominations to the banknote strapper 800, and removes a strapped bundle of banknotes from the banknote strapper 800 and places the bundle at a predetermined position.

[0033] Preferably, the automatic banknote handling system 1 further includes a controller 100 that controls at least the second arm 400 and the third arm 700. The controller 100 controls the third arm 700 to obtain an unsorted banknote from the banknote sorter 600 and pass the unsorted banknote to the second arm 400. The controller controls the second arm 400 to place the banknote again in the entrance portion of the banknote sorter 600.

[0034] A method for automatically handling banknotes using an automatic banknote handling system 1 is provided according to the above embodiment. The method includes transporting a banknote storage container 10 for storing banknotes, unlocking the banknote storage container 10, opening a lid of the banknote storage container 10, removing the banknotes stored in the banknote storage container 10, aligning the banknotes, sorting the banknotes by denominations, and strapping the bank-

notes sorted by denominations.

[0035] The embodiments disclosed herein are only illustrative in all respects and should not be construed to be restrictive. The scope of the invention is not defined by the embodiments described above but is defined by the appended claims, and all changes that come within the meaning and range of equivalency of the claims are intended to fall within the claims.

10 Reference Signs List

[0036]

1	system
10	banknote storage container
11	lid
50	base
100	controller
110	CPU
120	memory
160	communication interface
200	transporter
201	first conveyor
202	second conveyor
210	reverser
220	detector
300	first arm
310	key
400	second arm
410	gripper
420	camera
500	banknote aligner
600	banknote sorter
700	third arm
710	gripper
800	banknote strapper
900	storage box

40 Claims

1. An automatic banknote handling system, comprising:

- 45 a transporter that transports a banknote storage container for storing banknotes;
- a first arm that unlocks the banknote storage container and opens a lid of the banknote storage container;
- 50 a banknote aligner that aligns the banknotes;
- a banknote sorter that sorts the banknotes placed in an entrance portion by denominations;
- a second arm that removes the banknotes stored in the banknote storage container, places the banknotes on the banknote aligner, and places the aligned banknotes in the entrance portion of the banknote sorter;
- 55 a banknote strapper that straps the banknotes;

and

a third arm that passes a predetermined number of banknotes sorted by denominations to the banknote strapper, and removes a strapped bundle of banknotes from the banknote strapper and places the bundle at a predetermined position. 5

2. The automatic banknote handling system according to claim 1, further comprising: 10

a controller that controls at least the second arm and the third arm, wherein the controller controls the third arm to obtain an unsorted banknote from the banknote sorter and pass the unsorted banknote to the second arm, and the controller controls the second arm to place the banknote again in the entrance portion of the banknote sorter. 15 20

3. A method for automatically handling banknotes using an automatic banknote handling system, the method comprising: 25

transporting a banknote storage container for storing banknotes; unlocking the banknote storage container; opening a lid of the banknote storage container; removing the banknotes stored in the banknote storage container; aligning the banknotes; sorting the banknotes by denominations; and strapping the banknotes sorted by denominations. 30 35

40

45

50

55

1 ↗

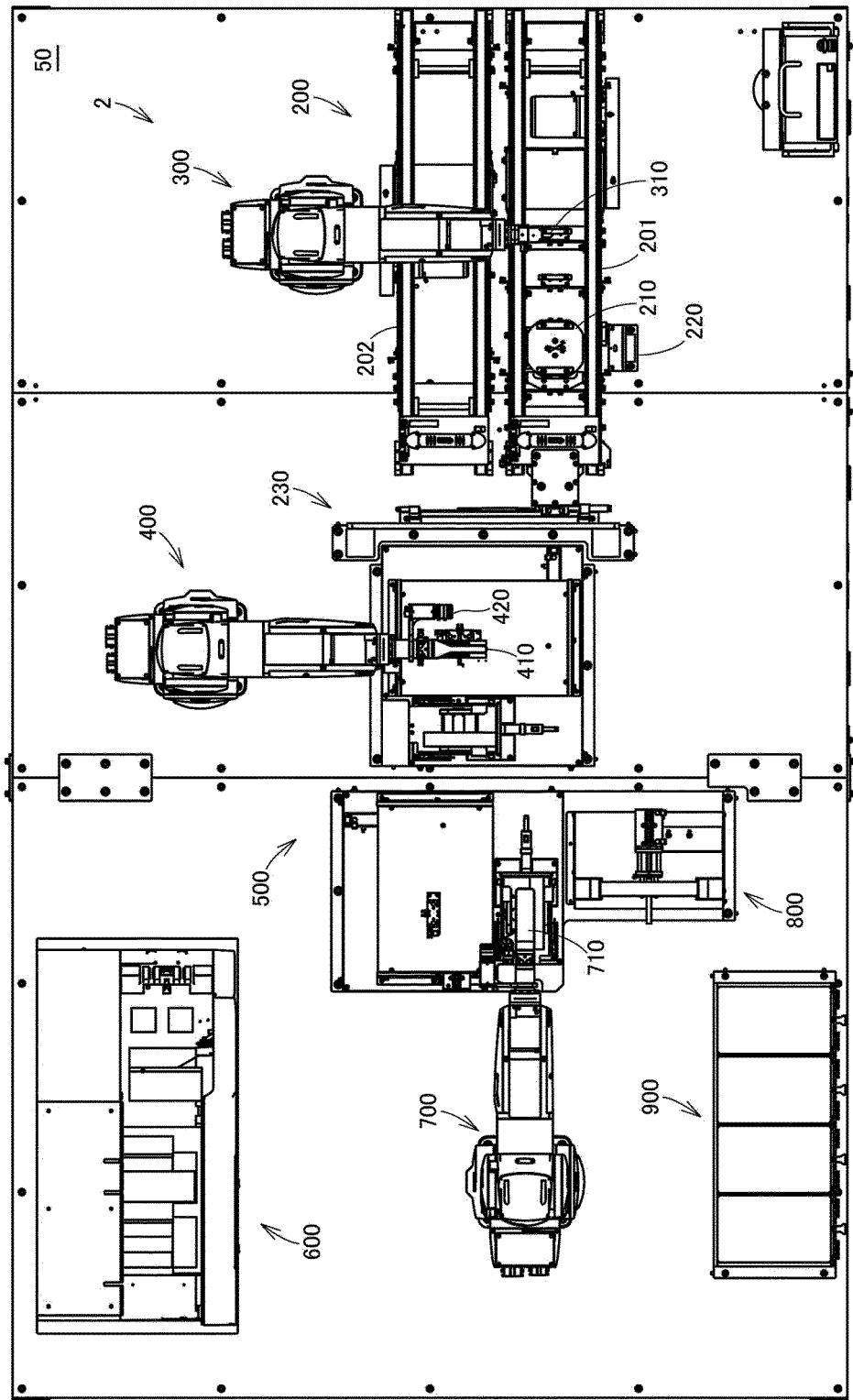


FIG. 1

FIG. 2

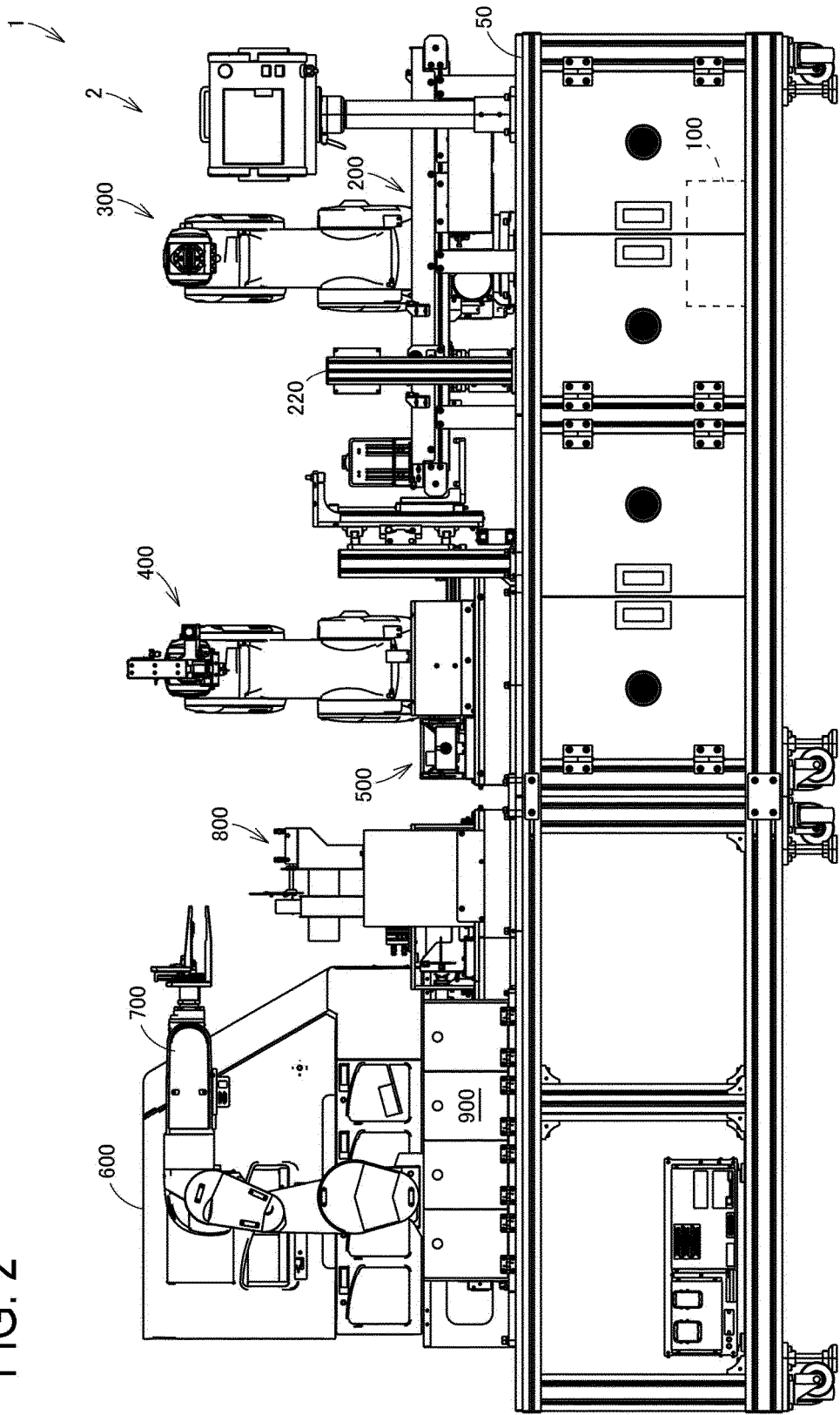


FIG. 3

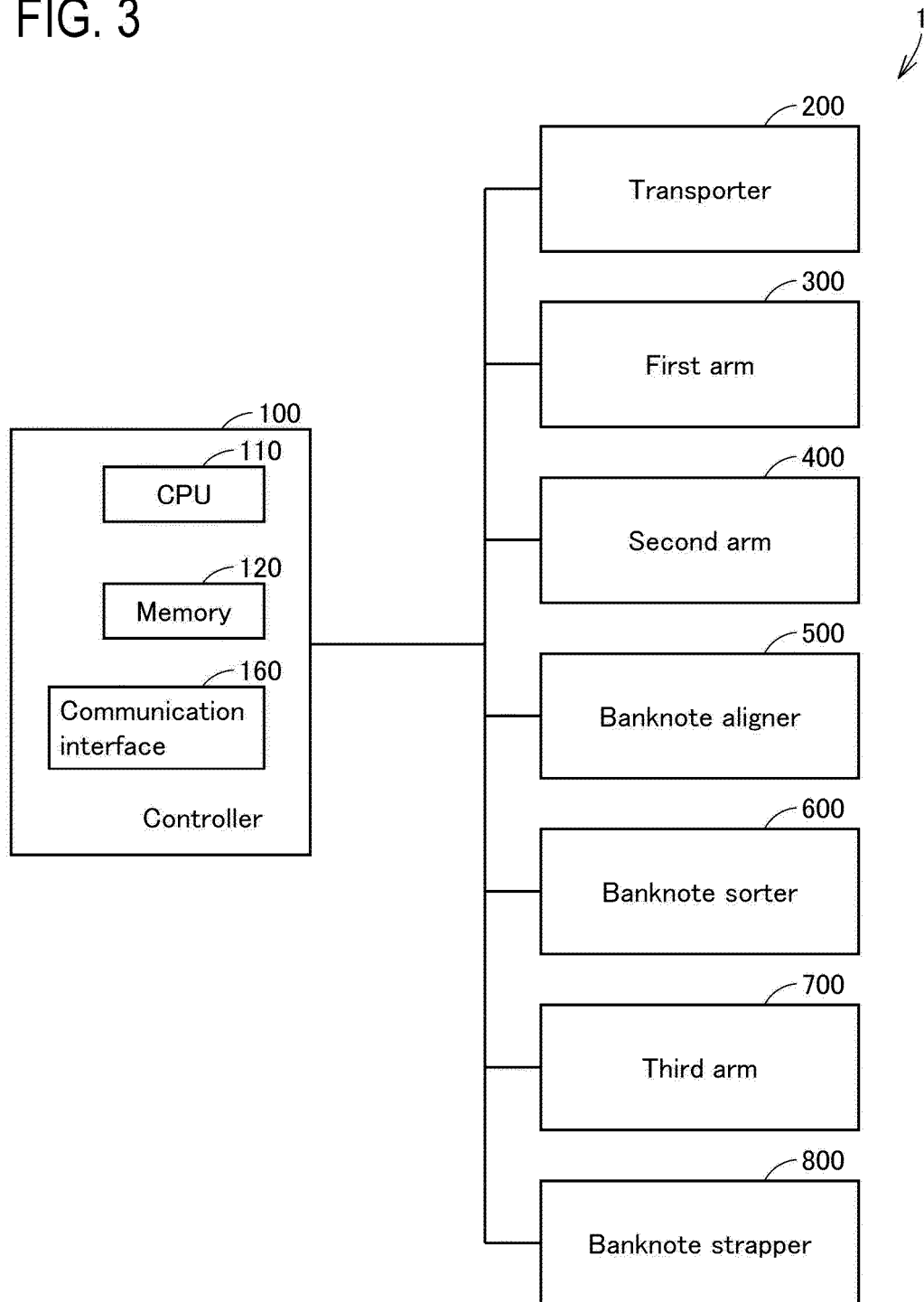


FIG. 4

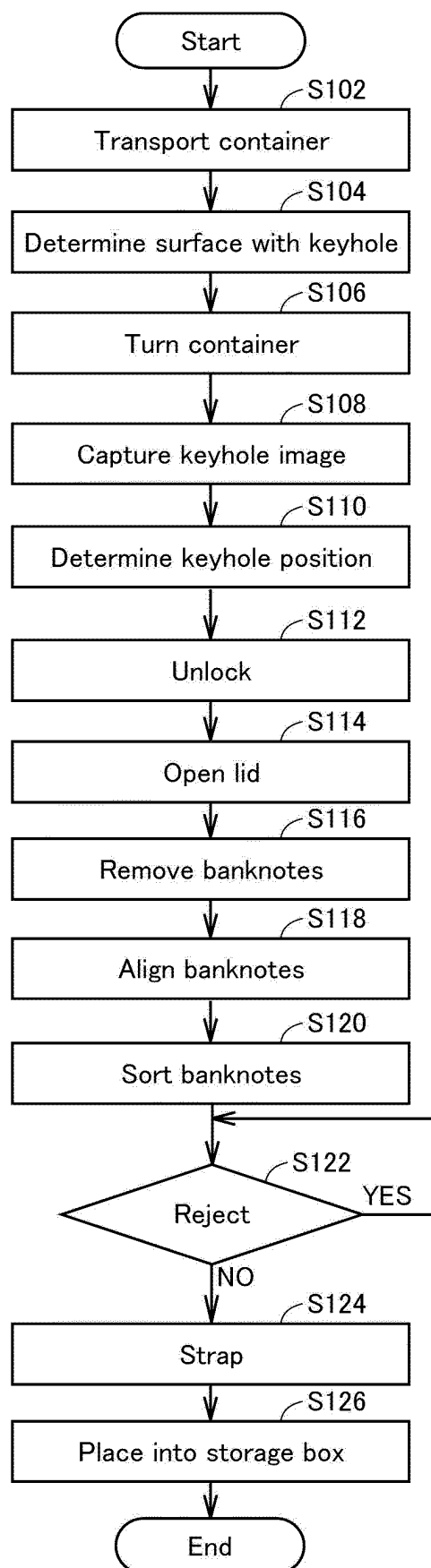
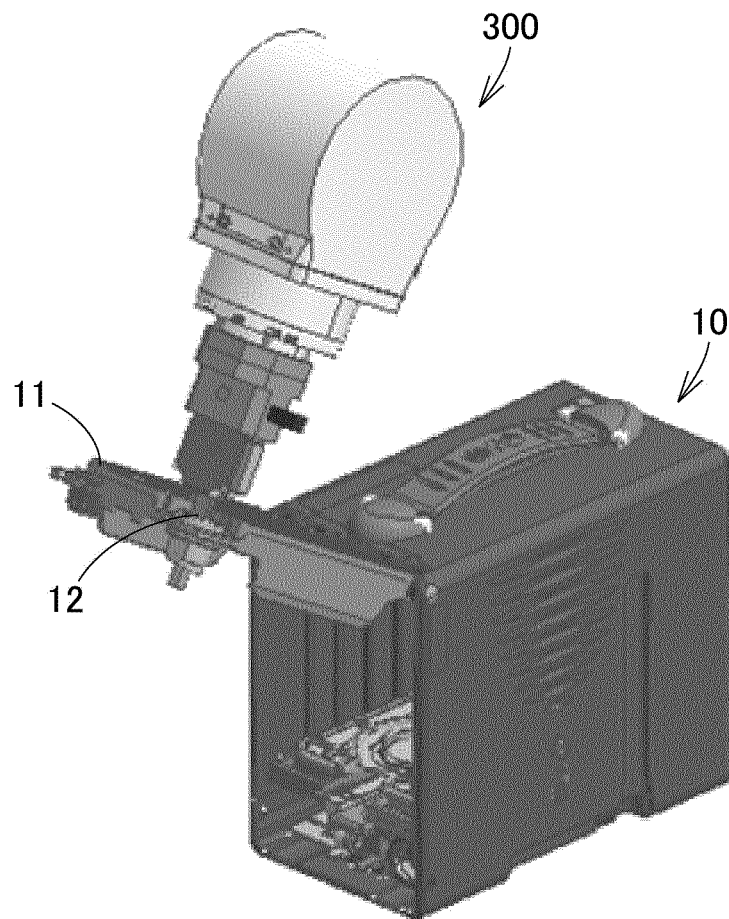
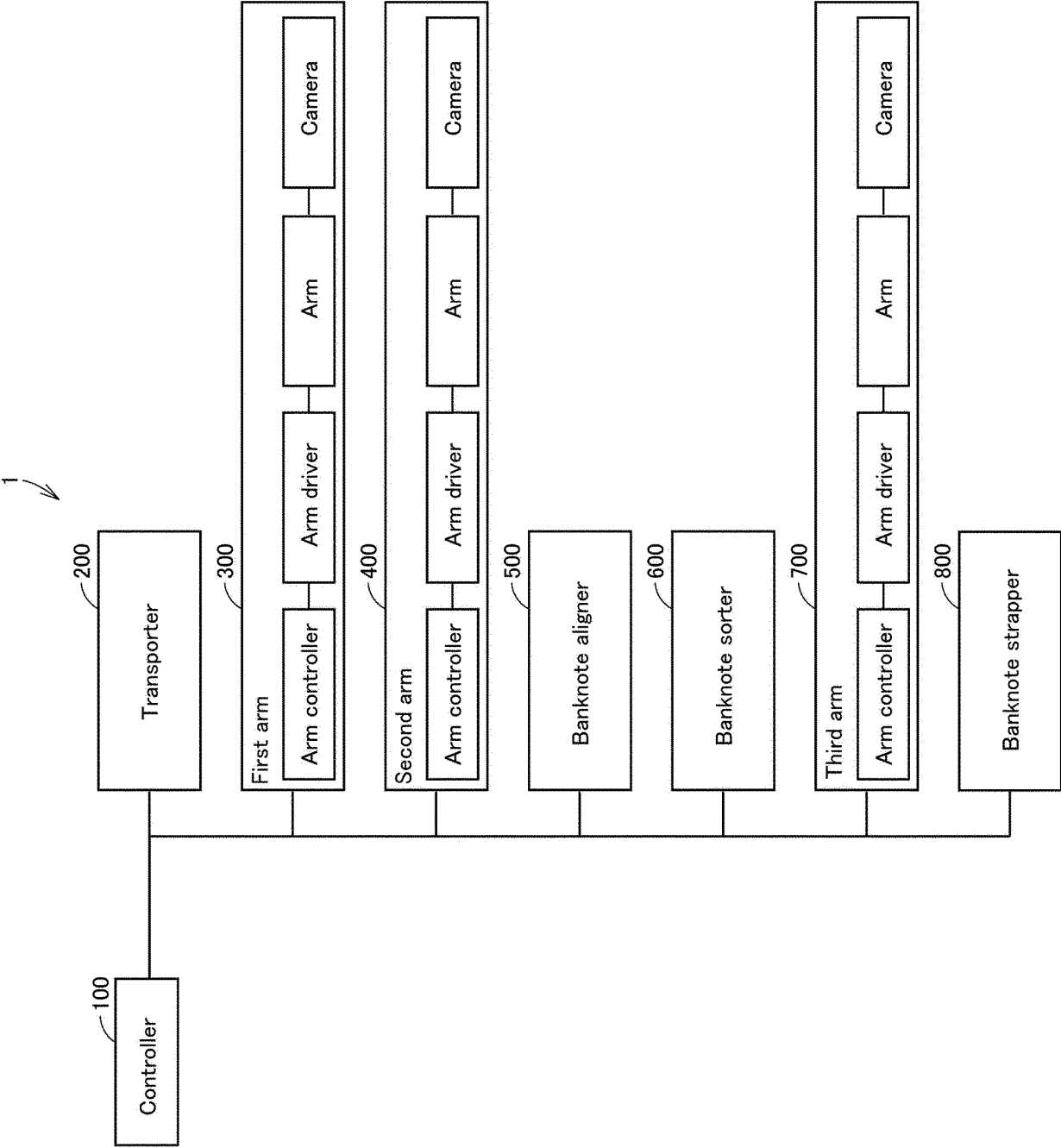


FIG. 5





INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/016240

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. G07D11/00 (2019.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. G07D11/00-11/60, B65B13/00-13/34, B65B27/08, B65H1/30, B65H3/16-3/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2019

Registered utility model specifications of Japan 1996-2019

Published registered utility model applications of Japan 1994-2019

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 207148954 U (GLORY KOGYO KK) 27 March 2018, paragraphs [0059]-[0134], fig. 1-9 (Family: none)	1-3
A	JP 62-92095 A (NEC CORP.) 27 April 1987, page 2, lower left column, line 7 to page 3, upper right column, line 2, fig. 1-3 (Family: none)	1-3



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
17 July 2019 (17.07.2019)Date of mailing of the international search report
30 July 2019 (30.07.2019)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 62092095 A [0002] [0005]
- JP 2016031619 A [0003] [0005]
- JP 2016224664 A [0004] [0005]